Innovative business models for smart cities – A systematic review

Nisha Shetty, Suresh Renukappa, Subashini Suresh

Abstract: ***Cities are the engines of growth for a nation. Smart technologies can help address the urban challenges and improve quality of life, economic opportunity, and liveability for citizens. Cities benefit from a transparent overview of best practice solutions to become smarter and from identifying best-suited solution providers. Companies that make cities smarter benefit from becoming more visible to cities around the globe with their newly developed or proven solutions. Innovative business models help accelerate the adoption of smart technologies. Various funding mechanisms have been used by cities to develop smart city projects. However, it has been revealed that the literature does not provide enough thoughts on these concepts. This paper provides an insight to the concept of innovative business models and the adoption of these in smart cities. Further the paper advances the understanding on the evolving business models and city procurement policies that could be used to accelerate smart city development. The paper seeks to address the question: What are the challenges faced by organisations and smart cities to develop a successful innovative business model? Cities have designed well defined strategies and are in the process of developing strategies for smart city. The paper address the challenges and functions of an innovative business model for development of smart cities.***

Keywords **: Innovative business models, smart cities, smart solution, challenges, economy**

I. INTRODUCTION

Cities are responsible for the socio-economic development and quality of life. An amount of 38.9 billion dollars is estimated to be spent on smart cities [1]. Cities are the engines of growth and play a very important role to achieve faster growth, which will inevitably imply a structural transformation and a rising share of industry and services sectors. Planning for urbanization and better management of cities is therefore not only important for the quality of life for those living in our cities and towns, but also because it contributes to a better investment climate. Smart city is an understandable concept based on the ideologies for citizens and industries. Cities need to be efficient, sustainable, equitable and livable [3]. Smart cities are characterised with technological innovations, policy innovations and the management innovation [5]. IoT is the emerging technology in the context of smart cities and is being set up for different projects. Use of IoT as a technology to connect between the physical and virtual world in the field of waste management could help in significant and fundamentals ways [14]. As a challenge to urban sustainability, smart cities are gaining the attention and momentum positively.

Business strategies are developed to reduce costs and resources with the inclusion of value proposition. Likewise, they have always been at the origin of social innovation. Business models have routed its way through smart cities. Business model can be defined by three core components of creating, delivering and capturing value in the economic, social and cultural forms of value [13]. The importance of business models in smart cities has developed tremendously due to the number of stakeholders involved in the process. Every service involved in the context of smart cities connected with a value proposal following contemporary or innovative business models [13]. Business models provide an architectural design for smart cities and provide the government with strategies to meet customer expectations. design for smart cities and provide the government with strategies to meet customer expectations. The concept of business models is encapsulated by three core principles of value proposition, value creation and delivery and value capture.

The paper addresses the research gap in innovative business models for smart cities. It further analyses the literature and provides a working definition of innovative business model. It investigates the management and organisational problems and advances with the basic elements of an innovative business model for the development of smart cities. The research provides answers to the research question: What are the challenges faced by organisations and smart cities to develop a successful innovative business model?

II. RESEARCH METHODOLOGY

The paper follows a structured literature review. A database search on Scopus was conducted, followed by cross-referencing snowballing procedure to identify the relevant studies. As shown below:

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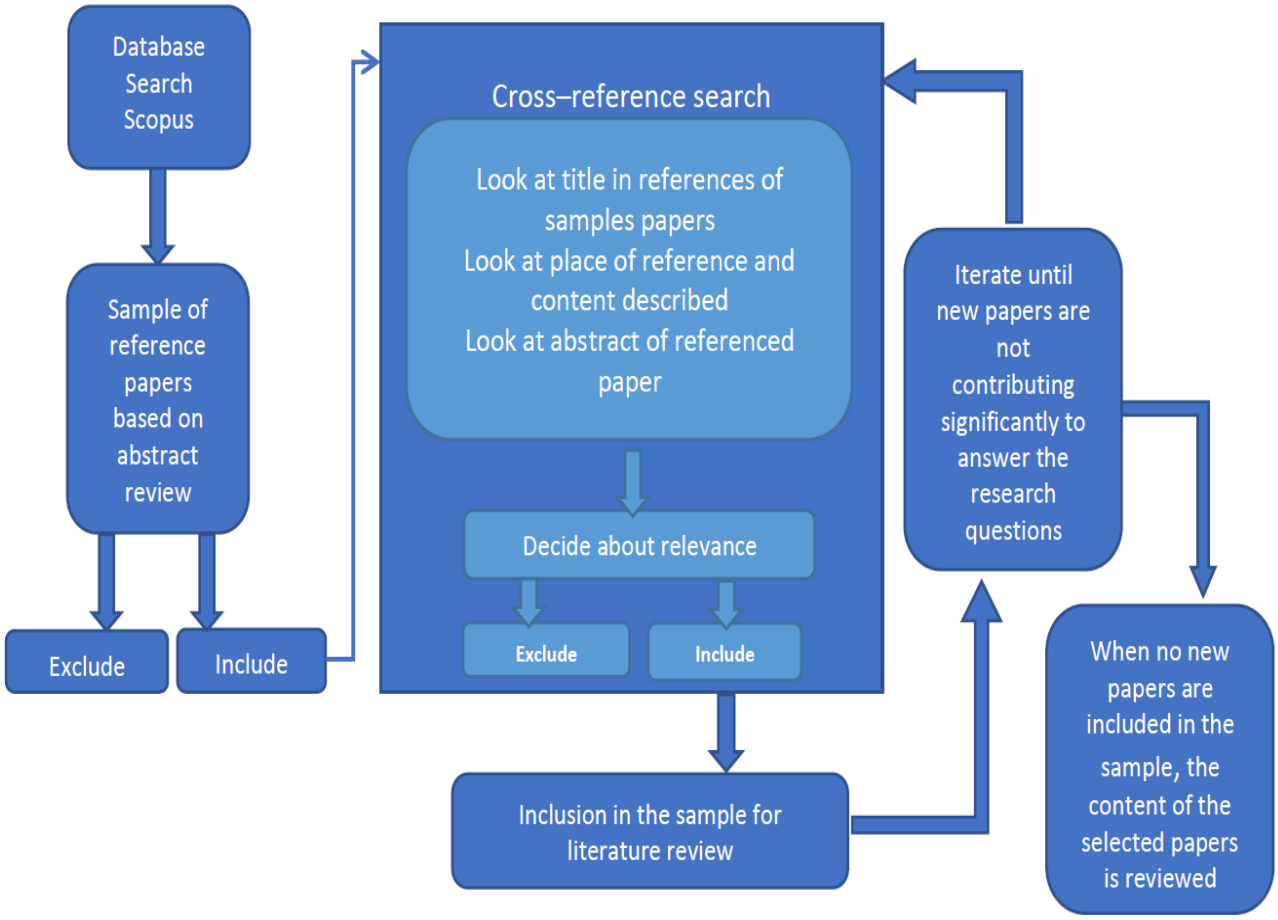

Fig 1. *Developed illustration adapted on the literature review approach Adopted from (Geissdoerfer et al., 2017)*

As shown in Fig 1 the search strings "business model", "innovative business model" and ""innovative business model" and "smart cities"' were searched in 'Article Title' in the Scopus database. The filtered articles, abstracts were perused to obtain the initial sample for literature review. Further the inclusion and exclusion criteria were added to the selected articles and the first relevant sample selected. Relevant cross-references were identified in the initial sample and the publications in the reference and cited in the text. The abstracts of these publications were examined to check the relevancy to the study. The similar process is continued unless no further papers are contributing to the study. Finally, a sample of papers were assimilated and compiled to review the literature.

III. DEFINING INNOVATIVE BUSINESS MODELS

A systematic review of the business model innovation literature was conducted to conceptualize an innovative business model definition. Various definitions were identified which were interpreted and synthesized into working definitions. Business model innovations are questioned about the higher returns compared to product or process innovations [22]. Innovation on the business model level would be a prerequisite in which incentives and revenue mechanisms could be associated in order to regulate sustainable solutions [18]. In the stream of working on business models, business model innovation is an implicit part of the conceptualization [15]. Business model innovation can be defined based on different circumstances. Product innovation, service innovation and changes in supply chain form the basis to qualify for an innovative business model. Innovating different business model elements provides an insight into succeeding an innovative business model. The table below gives different definitions for innovative business models.

Literature provides definitions in the context of business models for private business or organisations. Deriving a conceptual definition related to innovative business models for smart cities would be further required. The definitions provide an insight to business model innovation and change the configuration of the business model or the individual elements. Business model innovations have been configured on four basic concepts that comprise start-ups, business model transformation, business model diversification, and business model acquisition as explained below (Geissdoerfer 2018).

- Start-ups – there is no current business model and a new business model is created.
- Business model transformation – There is a current business model that is changed into another business model.
- Business model diversification – The current business model stays in place and an additional business model is created.

Table 1: Literature search strings

Search String	Search field	Excluded articles (Scopus)
Business model	Title/Article Title	80
Innovative business model	Topic/Article title, Abstract, Keywords	75
innovative business model" and "smart cities	Topic/Article title, Abstract, Keywords	58

Table 2: Innovative business model definitions

Source	Definition
Mitchell and Coles, 2004	"By business model innovation, we mean business model replacements that provide product or service offerings to customers and end users that were not previously available. We also refer to the process of developing these novel replacements as business model innovation.
Labbé and Mazet, 2005	A business model innovation changes one or more dimensions of a business model (which are perceived by the authors as product-market combination, the architecture of the value creation, and the revenue model) so that a novel configuration of the elements is created and implemented.
Osterwalder and Pigneur, 2005	"Specifying a set of business model elements and building blocks, as well as their relationships to one another, a business model designer, can experiment with these blocks and create completely new business models, limited only by imagination and the pieces supplied."
Chesbrough, 2007	Business model innovation is to "advance [the] business model,from very basic (and not very valuable) models to far more advanced (and more valuable) models."
Lindgardt et al., 2009	"Innovation becomes BMI [business model innovation] when two or more elements of a business model are reinvented to deliver value in a new way. BMI can provide companies a way to break out of intense competition, under which product or process innovations are easily imitated".
Romero and Molina, 2009	"business models as definers of the value creation priorities in an organisation should be continuously reviewed in response to actual and possible changes in the perceived market conditions and evolve the enterprise strategy as the business environment and customers' needs change."
Chesbrough, 2010	Business model innovation " Articulates the value proposition (i.e., the value created for users by an offering based on technology); Identifies a market segment and specify the revenue generation mechanism (i.e., users to whom technology is useful and for what purpose); Defines the structure of the value chain required to create and distribute the offering and complementary assets needed to support position in the chain; Details the revenue mechanism(s) by which the firm will be paid for the offering; Estimates the cost structure and profit potential (given value proposition and value chain structure); Describes the position of the firm within the value network linking suppliers and customers (incl. identifying potential complementors and competitors); and Formulates the competitive strategy by which the innovating firm will gain and hold advantage over rivals."
Johnson, 2010	"Calls for the ability to innovate something more core than the core, to innovate the very theory of the business itself. I call that process business model innovation."
Geissdoerfer et al., 2016	"Business model innovation describes either a process of transformation from one business model to another within incumbent companies or after mergers and acquisitions, or the creation of entirely new business models in start-ups."

Different definitions provide a consolidated working definition for innovative business models. Business model innovation could be defined based on the analysis: as the representation and implementation of new business models. The development of an entirely new business model with divergence into additional business models, the acquisition of new business models, or the transformation from one business model to another. The transformation can affect the entire business model or individual or a combination of its value proposition, value creation and deliver, and value capture elements, the interrelations between the elements, and the value network.

IV. INNOVATIVE BUSINESS MODELS FOR SMART CITIES –CONCEPTUALISATION OF ELEMENTS

Business model innovation describes the design process for giving birth to a fairly new business model on the market, which is accompanied by an adjustment of the value proposition and/or the value constellation and aims at generating or securing a sustainable competitive advantage (Diaz-Diaz 2017). As defined by (Geissdoerfer 2018), business model innovation is "the conceptualisation and implementation of new business models. This can compromise the development of entirely new business models, the diversification into additional business models the acquisition of new business models, or the transformation from one business model to another. The transformation can affect the entire business model or individual or a combination of its value proposition, value creation and deliver value capture elements, the interrelations between the elements, and the value network". The above definitions provided gives a general view of the importance a business model innovation provided through value proposition and the inclusion of product, service and supply chain innovation.

Nine building blocks of a successful business model to strengthen the services, customer interface, infrastructure management and financial aspects of a smart city are developed by [14]. Value proposition gives an overview of the services provided by a company. In a customer interface: the target customer describes the segments to offer value to, distribution channel helps to get in touch with the customer and relationship builds the link between the company and customer. Focusing on the strengthening of the infrastructure, value proposition, core competency and partner network are the most important factors to be considered for the execution of an efficient business model. Financial aspects such as cost structure and revenue model sums up the monetary consequences of a business model. A business model needs to be strategized by focusing on building long-term relationships, government commitment, future vision, taking standards based approach, creating investment opportunities and engaging citizens with the use of technology.

The different elements of the business model for smart cities analyses the relationship between them and discuss the manner of innovation on different elements that influence one another in the process. As analysed by Diaz-Diaz, the business model canvas can be used as a double benchmarking system to compare different public services. A comparison with the conventional method and innovative methodology has provided a result with social and environmental significances and improved management efficiencies. Business model canvas is adapted from (Osterwalder 2010). The key elements to be considered for innovative business models for smart cities are

- Key Partners: who would be responsible for the execution of the projects
- Key Activities: The process that needs to be followed to conduct the smart city projects.
- Value Proposition: the core of the business model describes what needs to be done to deliver and capture value.
- Customer Segments: describes the interaction with customers.
- Key Resources: Is associated with key activities and the cost structure.
- Channels: how to reach the customers with desired delivered value.

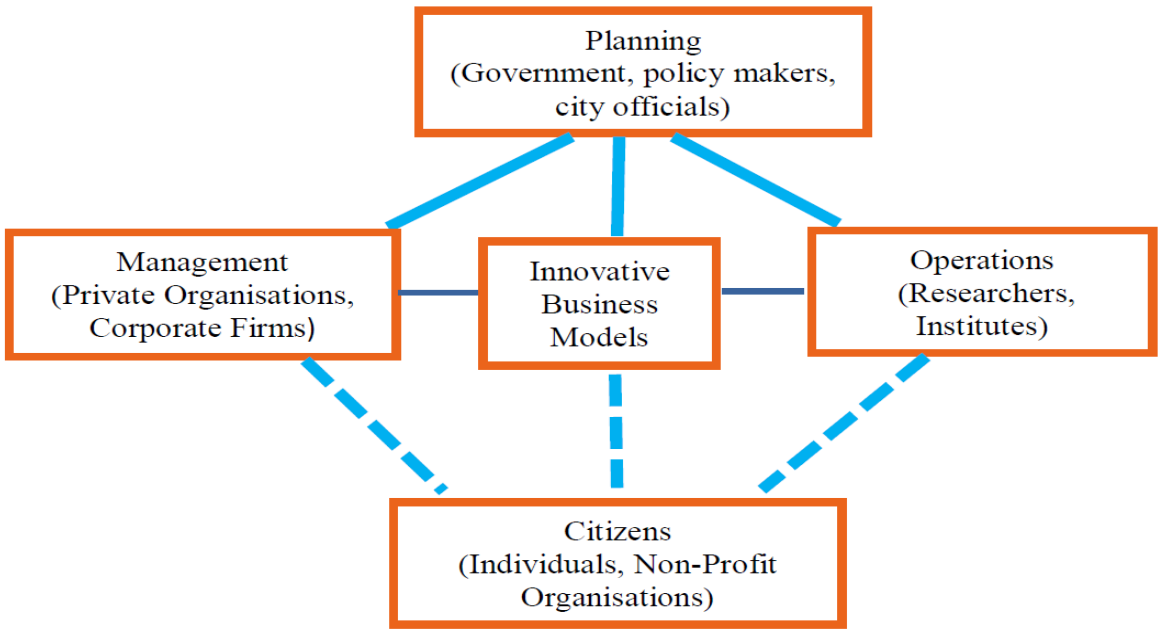

Figure 2: Demonstrating the business model functions for smart city development

- Cost Structure: The finances and budget requirement.
- Revenue Streams: profits and the delivery of profits from the executed projects.
- Social and Environmental Costs, Social and Environmental Benefits: the added significance of environmental and social costs which includes social and environmental benefits.

An initial framework designed (Fig 2) adopted with reference from the business model canvas along with four major components augmented from literature provides an insight into the innovative business models for smart cities.

An innovative business model focusing on the key elements to modify, improve reduce increase could help in the improvement of fundamental decisions for smart cities. The challenge faced is to create a collaborative approach to innovation ecosystems based on sustainable partnerships among the main stakeholders from business, research, policy and citizen groups and achieve an alignment of local, regional policy levels and resources. From the perspective of smart cities, managing innovation at the level of urban innovation ecosystems becomes a task of managing the portfolio of resources and promoting fruitful interlinkages. Smart city innovation ecosystem management aims to manage the portfolio of "innovation assets" made up of the different facilities and resources, by creating partnerships among actors that govern these assets, by fostering knowledge and information flows, and by providing open access to resources made available to users and developers (Schaffers,2011). The transformation to smarter cities will require innovation in planning, management, and operations. Integrating the system provides and optimizes the key metrics and performance indicators (Naphade 2011). Sensing, information management, analytics and modelling and influencing outcomes are the main functions characterized for smart city business model development. Cities and regions around the world are using technology innovation to improve their planning, management, and operations.

Planning, management and operations are the main functions of development which focus on the major hurdles for smart cities. Quality and costs of products used, privacy and security are the challenges faced during the sensing of city and its inhabitants. Managing different information models, access control standards and interoperability are maintained by different agencies within the same cities. City activities are understood through modelling and analytics which are a challenge the smart cities need to overcome with the right system models. Challenges faced in the level of influencing outcome, optimal system control and human-city interaction with people being the centre of city's transformation.

CONCLUSION

This paper provides a comprehensive review of the innovative business model for smart cities. The literature provides raw data and together with interpretation of this data and the definition of the key concept of innovative business model and a well-defined research gap. Innovative business model is at a very niche stage of research. The paper addresses the research gap in innovative business models for smart cities. It further investigates the management and organisational problems. A city encounters challenges in the planning, managing and operations phase. Overcoming these challenges with a developed business model provides an outcome with better interactions with citizens. Sensing, Information managing, observing and influencing are the challenges structured through the literature review. The research provides answers to the research question on the challenges faced by smart cities to develop innovative business models. The research question aims to generate descriptive knowledge about the process organisations/governments undergo to move into new innovative business models for smart cities development. Decision makers, academy, business and citizens provide the augmented process for a business model operation. Innovation in the key elements of a business model provide a further research topic on smart city innovative business models. The authors would further like to research and develop a concept based framework on innovative business models for smart cities.

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